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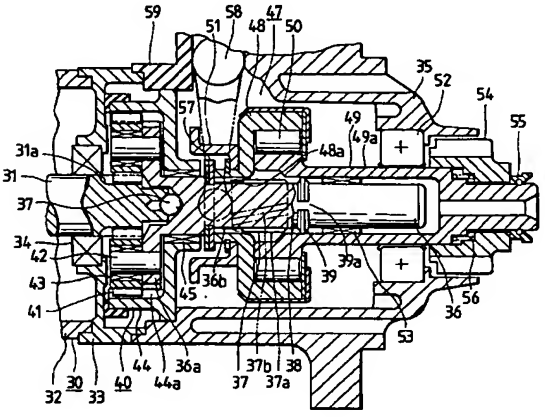
(54) Starter device.

(57) The invention relates to a starter device comprising an output shaft (36), an over-running clutch (47) and a stopper (39). A rotation of the armature shaft (31) of a DC motor (30) is transmitted to the output shaft (36). The output shaft (36) has a helical spline gear (37). The over-running clutch (47) includes a clutch outer (48) coupled to the output shaft (36) through the helical spline gear (37), and a clutch inner (49) which is coupled to the clutch outer (48) through rollers (50) to transmit rotation in one direction to a pinion (54) provided on the front end portion thereof. The over-running clutch (47) moves the pinion (54) forwardly and backwardly. The stopper (39) is formed on the output shaft (36) in front of the helical spline gear (37) to stop the forward movement of the clutch outer (48) at a predetermined position. The clutch inner (49) has a cylindrical portion extended forwardly which is supported through a bearing (52) on the front bracket (35) of the DC motor (30). The inside diameter of the cylindrical portion of the clutch inner (49) is slightly larger than the outside diameters of the helical spline gear (37) and stopper (39) on the output shaft (36) so as to allow the cylindrical portion to cover at least a portion of the helical spline gear (37) and stopper (39). Thereby, the starter device is reduced in length due to the reduction of the over-running clutch (47) in length.

FIG. 1



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Background of the Invention

This invention relates to a starter device in which rotation of the armature shaft of a DC motor is applied through a speed reducer or directly to the output shaft, and rotation of the output shaft is transmitted through an over-running clutch to a pinion thereby to start the engine.

Fig. 2 is a longitudinal sectional view showing essential components of a conventional starter device which has been disclosed, for instance, by Japanese Utility Model Application Publication No. 53727/1980. In Fig. 2, reference numeral 1 designates a DC motor, the armature shaft 2 of which is extended into an output shaft 3; 4, a helical spline gear formed on the output shaft 3, the helical spline gear being made up of a plurality of elongated grooves or keyways 4a spaced at equal angular intervals and a plurality of auxiliary through keyways 4b each formed between two adjacent keyways 4a; 5, a stopper formed on the output shaft with an annular groove 6 between the stopper 5 and helical spline gear 4, the stopper 5 having through keyways 5a which communicate with those 4b of the helical spline gear 4 (the helical spline gear 4 and the stopper 5 shown in Fig. 3 in more detail); 7, the front bracket of the DC motor 1; and 8, a partition board.

Further in Fig. 2, reference numeral 10 designates an over-running clutch mounted on the output shaft 3. The over-running clutch 10 comprises a clutch outer 11 and a clutch inner 12. The clutch outer 11 has helical spline keys 11a formed in its inner cylindrical wall which are engaged with the keyways 4a of the helical spline gear 4 of the output shaft 3. The clutch inner 12 transmits rotation in one direction with the aid of a plurality of rollers 13. The clutch inner 12 has a cylindrical portion 12a extended forwardly, and a pinion 14 is cut integral with the cylindrical portion 12a. The cylindrical portion 12a of the clutch inner 12 is supported through a bearing 15 on the front bracket 7, and supports the front end portion of the output shaft 3 through a bearing 13. Since the cylindrical portion 12a of the clutch inner 12 is supported through the bearing 15 as was described above, the outside diameter thereof should be equal to or larger than the outside diameter of the pinion 14. Thus, the clutch inner is relatively large in weight.

Further in Fig. 2, reference numeral 17 designates an electro-magnetic switch mounted on the front bracket. When the exciting coil (not shown) of the electro-magnetic switch 17 is energized, the plunger 18 is magnetically retracted or moved backwardly. The plunger 18 is engaged with the upper end portion of a shift lever 19 in the form of a fork, the lower end portion of which is engaged with the over-running clutch 10 to move the latter in an axial direction. That is, when the shift lever 19 is turned counterclockwise, the over-running clutch 10 is moved forwardly; and when it is turned clockwise, the clutch is moved backwardly. Further in Fig. 2, reference numeral 20 designates a torsion spring which is adapted to restore the shift lever 19 by turning it clockwise, and thereby to return the plunger 18 to its original position; and 21, the ring gear of the engine with which the pinion 14 meshes when moved forwardly.

The above-described over-running clutch 10 is mounted on the output shaft 3 as follows: The helical spline keys 11a of the clutch outer 11 are passed through the through keyways 5a of the stopper 5 and then the through keyways 4b of the helical spline gear 4. Thereafter, at a small diameter clearance groove 3a formed in the rear end portion of the output shaft 3, the clutch outer 11 is turned by a half pitch of the keys 11a until the keys 11a are set in alignment with the keyways 4a of the helical spline gear 4 on the output shaft 3. Under this condition, the clutch outer is moved forwardly, so that the clutch outer and the output shaft are coupled to each other by helical spline engagement. In this case, the front end faces of the keys 11a of the clutch outer 11 abut against the rear end step of the stopper 5, thus inhibiting the forward movement of the clutch outer 11.

Now, the operation of the starter device thus constructed will be described. Upon energization of the exciting coil (not shown) of the electro-magnetic switch 17, the plunger is moved inwardly, to turn the shift lever 19 counterclockwise in Fig. 2. As a result, the over-running clutch 10 is moved forwardly to cause the pinion 14 to mesh with the ring gear 21. When the plunger 18 is moved backwardly as was described above, the movable contact of the electromagnetic switch is also moved backwardly, to engage with the pair of stationary contacts thereof, thus completing the armature circuit of the DC motor 1. As a result, the armature is rotated, and the rotation of the armature shaft 2; that is, the rotation of the output shaft 3 integral with the armature shaft 2 is transmitted through the over-running clutch 10 to the pinion 14 to rotate the ring gear 21, thereby to start the engine.

The above-described conventional starter device is however disadvantageous in the following points: That is, in the starter device, the cylindrical portion 12a of the clutch inner 12 is large in outside diameter, and therefore the clutch inner is large in weight, as a result of which the pinion 14 is not smoothly engaged with the ring gear 21. In order to mount the over-running clutch 10 on the output shaft 3, the helical spline keys 10a of the clutch outer 11 are engaged with the keyways 4a after passing through the through keyways 4b, and then the clutch outer is moved forwardly. Hence, it is necessary to space the rear end of the clutch inner 12 from the stopper 5 as much as L, and accordingly the over-running clutch 10 is extended forwardly as much, with the result that the starter device is relatively large in axial length.

Summary of the Invention

Accordingly, it is an object of this invention to eliminate the above-described difficulties accompanying a conventional starter device. More specifically, it is an object of the invention to provide a starter device in which the clutch inner is reduced in weight to allow the pinion to smoothly engage with the ring gear of the engine, and the over-running clutch is decreased in length, with the result that the starter device itself is reduced in axial length.

The foregoing object of the invention has been achieved by the provision of a starter device in which, according to the invention, the inside diameter of the cylindrical portion of the clutch inner is slightly larger than the outside diameters of the helical spline gear and the stopper for the clutch outer which are formed on the output shaft, and the outside diameter of the cylindrical portion is smaller than that of the rear end portion, with the over-running clutch being reduced in length. The front end portion extended from the cylindrical portion is made smaller in outside diameter than the latter, and a pinion to be engaged with the ring gear of an engine is mounted on the front end portion thus designed.

In the starter device of the invention, the cylindrical portion of the clutch inner covers the helical spline gear and the stopper for the clutch outer which are formed on the output shaft, so that the over-running clutch is reduced in length. Furthermore, since the cylindrical portion of the clutch inner is smaller in outside diameter than the rear end portion thereof, the clutch inner is reduced in weight as much, with the result that the axial moving member can be readily moved in the forward direction, thus allowing the pinion mounted on it to smoothly mesh with the ring gear of the engine.

Brief Description of the Drawings

Fig. 1 is a longitudinal sectional view showing essential components of one example of a starter device according to this invention;

Fig. 2 is also a longitudinal sectional view showing essential components of a conventional starter device; and

Fig. 3 is an enlarged diagram showing a helical spline gear and a stopper formed on the output shaft of the starter device shown in Fig. 2.

Detailed Description of the Preferred Embodiment

Fig. 1 is a longitudinal sectional view showing essential components of one example of a starter device according to this invention. The starter device, as shown in Fig. 1, comprises a DC motor 30, from the armature of which an armature shaft 31 is extended. A small gear, namely, a sun gear 31a is cut integral with the front end portion of the armature shaft 31. The starter device further comprises: a yoke 31; an intermediate bracket 33 which supports the front end portion of the armature shaft 31 through a bearing 34; and a front bracket 35 coupled to the yoke 32 through the intermediate bracket 33.

Further in Fig. 1, reference numeral 36 designates an output shaft coupled through a steel ball 37 to the front end of the armature shaft 31 in such a manner that the former 36 is coaxial with the latter 31. A helical spline gear 37 is formed on the middle portion of the output shaft. The output shaft has an annular groove 38 and a stopper 39 for the clutch outer in front of the helical spline gear 37. The helical spline gear 37 is made up of a plurality of elongated grooves, namely, keyways 37a spaced at equal angular intervals, and through keyways 37b each formed between two adjacent keyways 37a. The stopper 39 has a through cut 39a which is communicated with the through keyways 37b. The output shaft 36 has a clearance groove 36b smaller in diameter at the rear of the helical spline gear 37.

The starter device further comprises a planetary gear type speed reducer 40 which is designed as following. A plurality of planet gears 41 are engaged with the sun gear 31a and supported through bearings 43 by support pins 42, which are fixedly embedded in a carrier 36a which is a flange formed on the output shaft 36 the rear end. An internal gear frame 44 is fixedly secured inside the front bracket 35, and has an internal gear 44a cut integral with the inner cylindrical wall. The internal gear 44a is engaged with the planet gears 41 to revolve them. The front end portion of the internal gear frame 44 supports the rear end portion of the output shaft 36 through a bearing 46 inserted thereinto.

The starter device further comprises an over-running clutch 47 which includes a clutch outer 48 and a clutch inner 49. The clutch outer 48 has helical spline keys 48a which are engaged with the keyways 37a of the helical spline gear 47 on the output shaft 36. The clutch inner 49 is coupled to the clutch outer 48 through rollers 50 to transmit rotation in one direction. The clutch inner 49 has a middle portion 49a the inside diameter of which is made slightly larger than the outside diameters of the helical spline gear 37 and the stopper 39 so as to cover the latter 37 and 39. The outside diameter of the middle portion 49a is larger than that of the rear end portion of the clutch inner, so as to reduce the weight of the clutch inner. The clutch inner 49 is supported through a bearing 52 on the front bracket 35. Further in Fig. 1, reference numeral 51 designates an engaging ring; and 57 a snap ring mounted on the output shaft 36 to abut against the rear end of the clutch outer 48.

Further in Fig. 1, reference numeral 54 designates a pinion coupled to the front end portion of the clutch inner 49 by spline connection. A stopper 55

holds the pinion 54 at the front end, which is urged forwardly by a compression spring 56.

The over-running clutch 47 thus constructed is mounted on the output shaft 36 as follows: The helical spline keys 48a of the clutch outer 48 of the over-running clutch 47 are moved to the clearance groove 36b after passing through the through cuts 39a of the stopper 39 and through the through keyways 37b of the helical line gear 37. Under this condition, the clutch outer 48 is turned as much as a half of the pitch of the helical spline keys 48a until the keys are set in alignment with the keyways 37a of the helical spline gear 37 of the output shaft 36. Thereafter, the clutch outer is moved forwardly, so that the clutch outer and the output shaft are coupled to each other by spline connection. Under this condition, a snap ring 57 is fitted on the output shaft 36 to determine the rearward position of the clutch outer 48. When, under this condition, the over-running clutch 47 is moved forwardly, then the front end faces of the keys 48a of the clutch outer 48 abut against the stopper 39, thus determining the forward movement of the clutch outer.

The starter device further comprises a shift lever 58 for moving the over-running clutch 47 forwardly and backwardly. More specifically, the shift lever 58 is turned clockwise or counterclockwise respectively by the backward or forward movement of the hook coupled to the plunger of an electromagnetic switch (not shown) (sic). A closing member 59 of rubber is fitted in a cut formed in the front bracket 35.

The operation of the starter device thus designed is the same as that of the above-described conventional starter device except that, in the former, the rotation of the armature shaft 31 is transmitted through the planetary gear type speed reducer to the pinion 54.

As was described above, the embodiment includes the planetary gear type speed reducer 40; however, it should be noted that the technical concept of the invention is applicable also to a starter device in which no planetary gear type speed reducer is employed, and the extension of the armature shaft is employed as the output shaft.

In the starter device of the invention, the inner diameter of the cylindrical portion of the clutch inner is made slightly larger than the outside diameters of the helical spline gear and the stopper for the clutch outer which are formed on the output shaft, so as to cover them. Therefore, the over-running clutch is reduced in length as much; that is, it is small in axial dimension. Furthermore, since the cylindrical portion of the clutch inner is smaller in outside diameter than the rear end portion thereof, and the pinion is mounted on the front end portion of the clutch inner which is made smaller than the cylindrical portion, the clutch inner is reduced in weight as much, with the result that the axial moving member can be readily moved in the forward direction, thus allowing the pinion mounted on it to smoothly mesh with the ring gear of the engine.

Claims

1. A starter device comprising:

an output shaft to which rotation of the armature shaft of a DC motor is transmitted, said output shaft having a helical spline gear;

an over-running clutch including a clutch outer coupled to said output shaft through said helical spline gear, and a clutch inner which is coupled to said clutch outer through rollers to transmit rotation in one direction to a pinion provided on the front end portion thereof, said over-running clutch adapted to move said pinion forwardly and backwardly; and

a stopper formed on said output shaft in front of said helical spline gear, to stop the forward movement of said clutch outer at a predetermined position, said clutch inner having a cylindrical portion extended forwardly which is supported through a bearing on the front bracket of said DC motor;

wherein the inside diameter of said cylindrical portion of said clutch inner is slightly larger than the outside diameters of said helical spline gear and stopper on said output shaft so as to allow said cylindrical portion to cover at least a portion of said helical spline gear and stopper.

2. A starter device according to claim 1, wherein the outside diameter of said cylindrical portion of said clutch inner is smaller than that of the rear end portion thereof, and the outside diameter of the front end portion extended from said cylindrical portion is smaller than that of said cylindrical portion, and said pinion is mounted on said front end portion.

FIG. 1

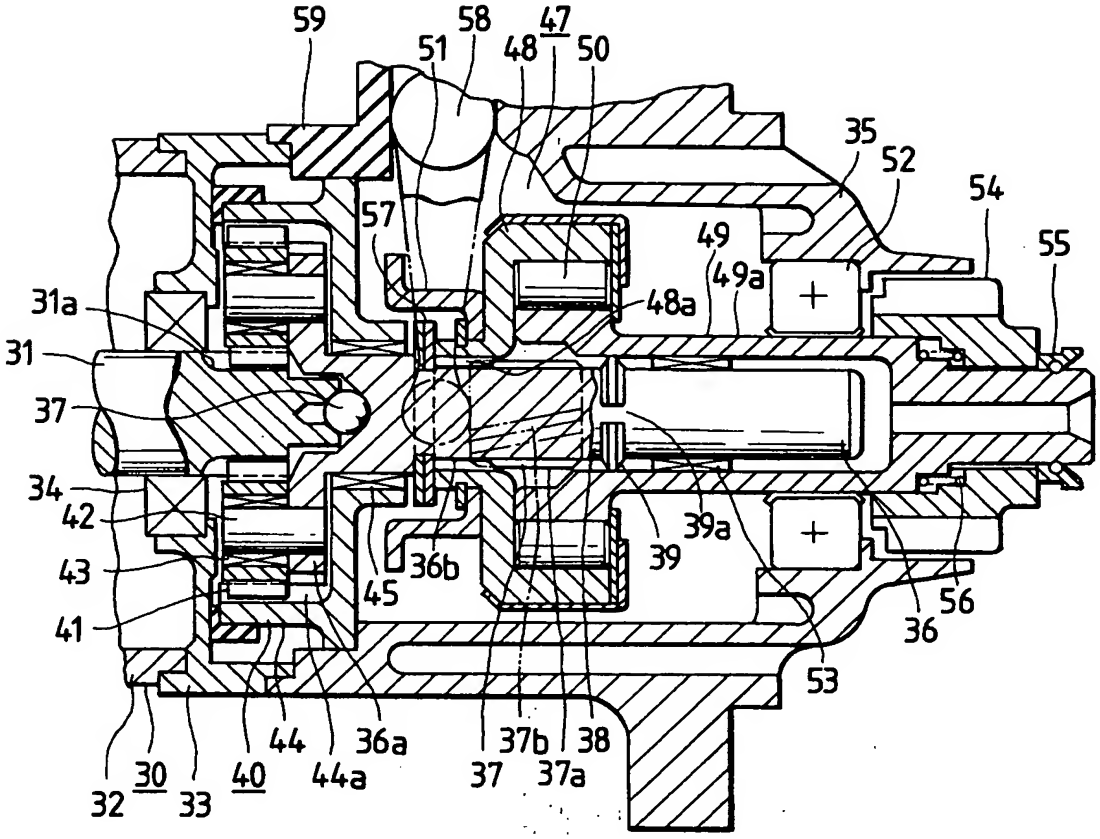
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FIG. 2

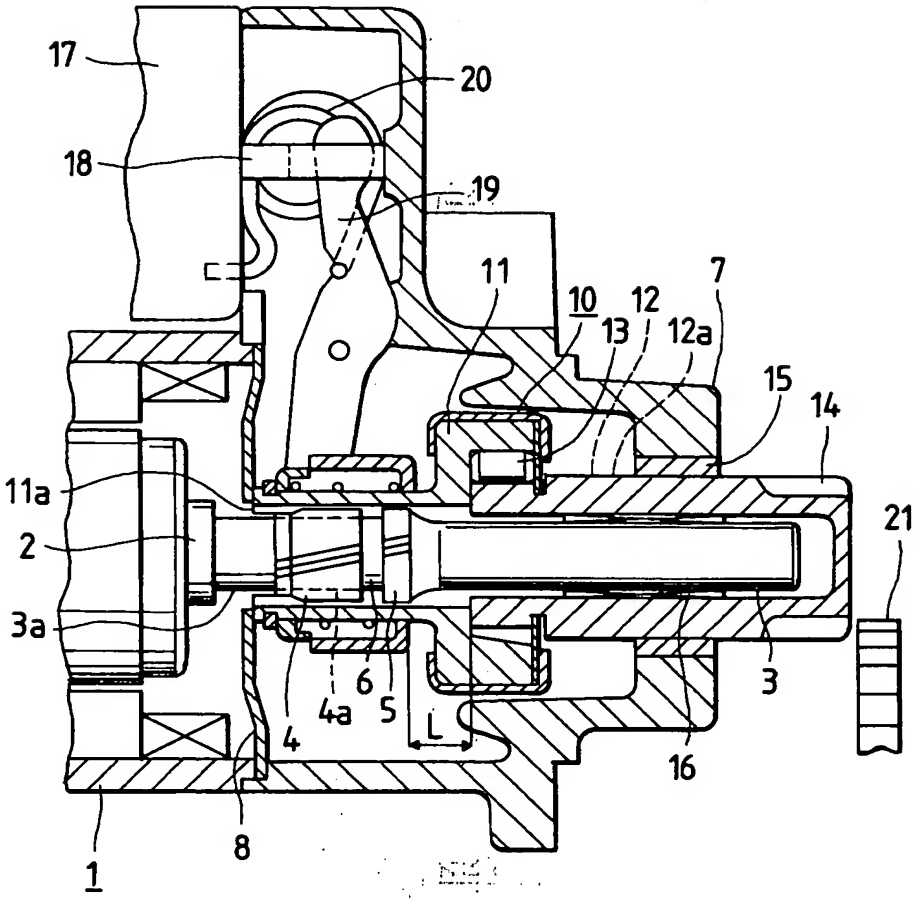
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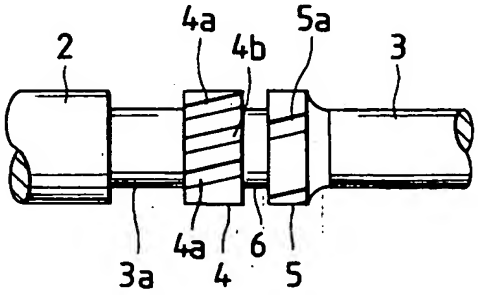
FIG. 3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EUROPEAN SEARCH REPORT

Application Number

EP 92 10 0335

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	FR-A-2 572 137 (SOCIETE DE PARIS ET DU RHONE.) * page 3, line 21 - page 4, line 8; figures 1-3 * ---	1	F02N15/06 F02N15/02
Y	US-A-4 902 905 (MORISHITA) * column 1, line 11 - line 41; figure 1 * ---	1	
A	FR-A-2 613 777 (MITSUBISHI DENKI K.K.) * page 5, line 18 - page 6, line 21; figure 1 * -----	1,2	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F02N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 APRIL 1992	BIJN E.A.

CATEGORY OF CITED DOCUMENTS

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